

HUMAN MARS MISSION
Launch Window from Earth Orbit

FINAL REPORT

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Human Mars Mission

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Introduction

The determination of orbital window characteristics is of major importance in the analysis of human interplanetary missions and systems. The orbital launch window characteristics are directly involved in the selection of mission trajectories, the development of orbit operational concepts, and the design of orbital launch systems.

The orbital launch window problem arises because of the dynamic nature of the relative geometry between outgoing (departure) asymptote of the hyperbolic escape trajectory and the earth parking orbit. The orientation of the escape hyperbola asymptotic relative to earth is a function of time. The required hyperbola energy level also varies with time. In addition, the inertial orientation of the parking orbit is a function of time because of the perturbations caused by the Earth's oblateness. Thus, a coplanar injection onto the escape hyperbola can be made only at a point in time when the outgoing escape asymptote is contained by the plane of parking orbit. Even though this condition may be planned as a nominal situation, it will not generally represent the more probable injection geometry. The general case of an escape injection maneuver performed at a time other than the coplanar time will involve both a path angle and plane change and, therefore, a ΔV penalty. Usually, because of the ΔV penalty the actual departure injection window is smaller in duration than that determined by energy requirement alone.

This report contains the formulation, characteristics, and test cases for five different launch window modes for Earth orbit.

These modes are:

- (1) One impulsive maneuver from a Highly Elliptical Orbit (HEO)
- (2) Two impulsive maneuvers from a Highly Elliptical Orbit (HEO)
- (3) One impulsive maneuver from a Low Earth Orbit (LEO)
- (4) Two impulsive maneuvers from LEO
- (5) Three impulsive maneuvers from LEO

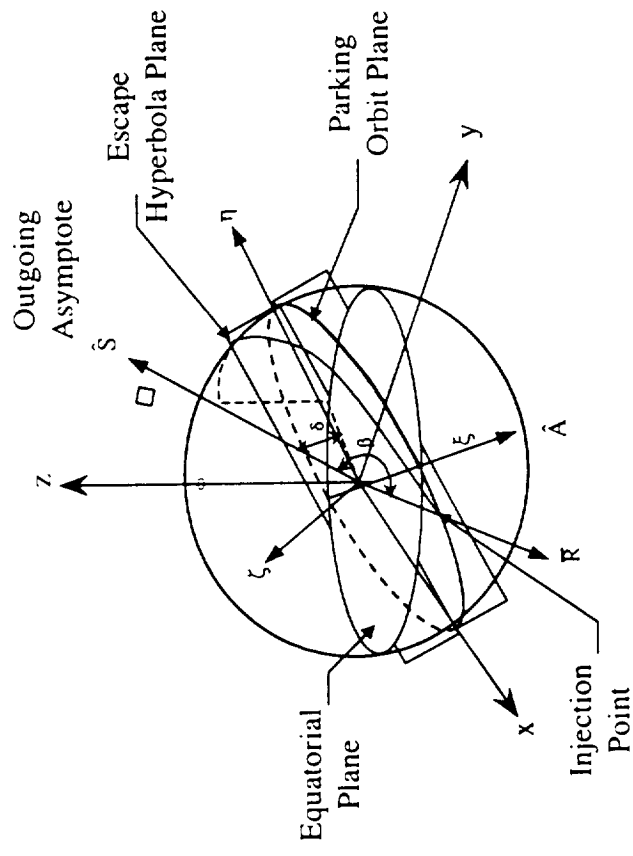
The formulation of these five different launch window modes provides a rapid means of generating realistic parametric data for space exploration studies. Also the formulation provides vector and geometrical data sufficient for use as a good starting point in detail trajectory analysis based on calculus of variations, steepest descent, or parameter optimization program techniques.

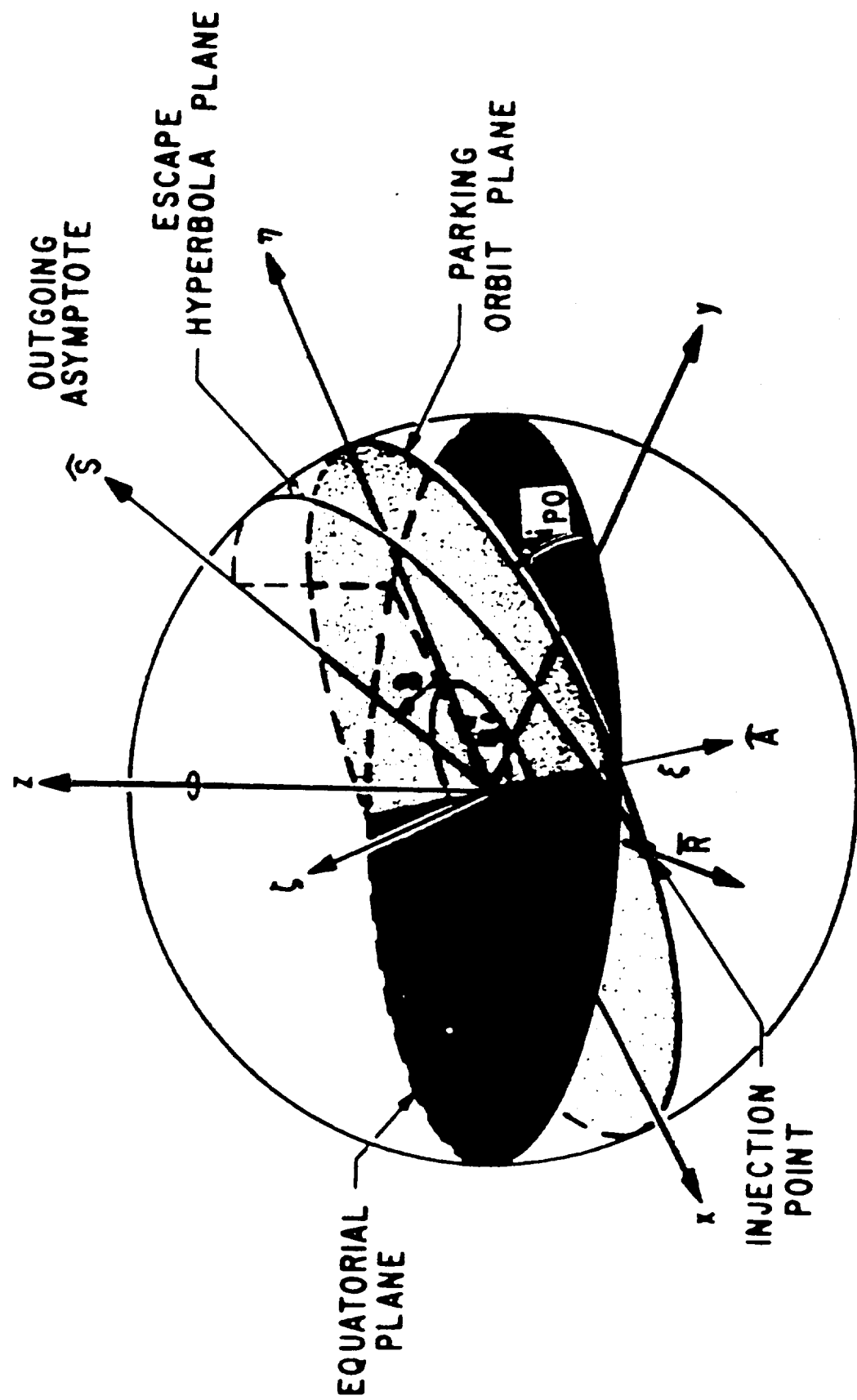
NON-COPLANAR ORBITAL LAUNCH GEOMETRY

The basic geometry of the completely general, non-coplanar orbital launch geometry is illustrated in this chart. The parking orbit plane is defined by orbit inclination and orbit ascending node. The escape hyperbolic conditions are defined by the outgoing asymptote vector (\vec{S}) right ascension (α) declination (δ) and C_3 (twice the total hyperbolic escape energy per unit mass). The parking orbit ascending node has a regression rate of -5.0 to -7.2 degrees per day for Low Earth Orbit (LEO). The angular orientation (α and δ) of the outgoing asymptote changes much slower, less than 1 degree per day. Because of the LEO regression rate, co-planar launch geometry exists for only a short period of time.

High Earth Orbit (HEO) (orbit period ~ 24 hour) ascending node regression rate is much smaller, ~ -0.10 degree per day. The required plane change between the HEO and the outgoing asymptote does not build up as fast as in the LEO case. The HEO conditions would exist for the SEP architecture. And the LEO conditions would exist for the nuclear thermal and chemical high thrust architectures.

Figure 1. Non-Coplanar Orbital Launch Geometry





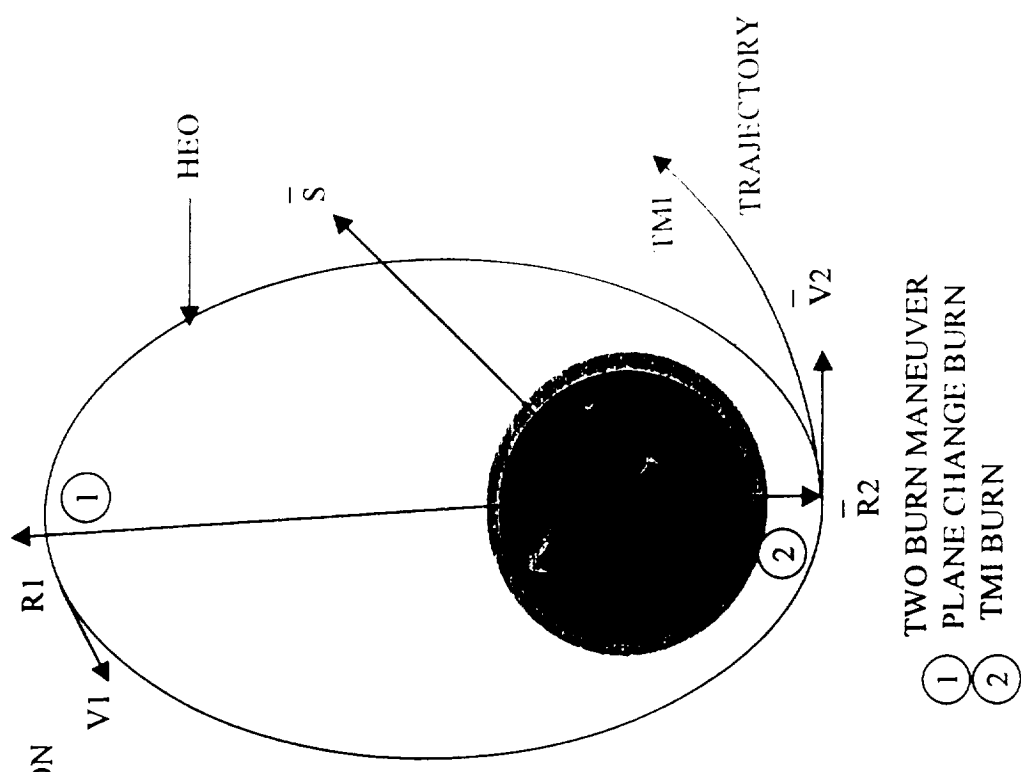
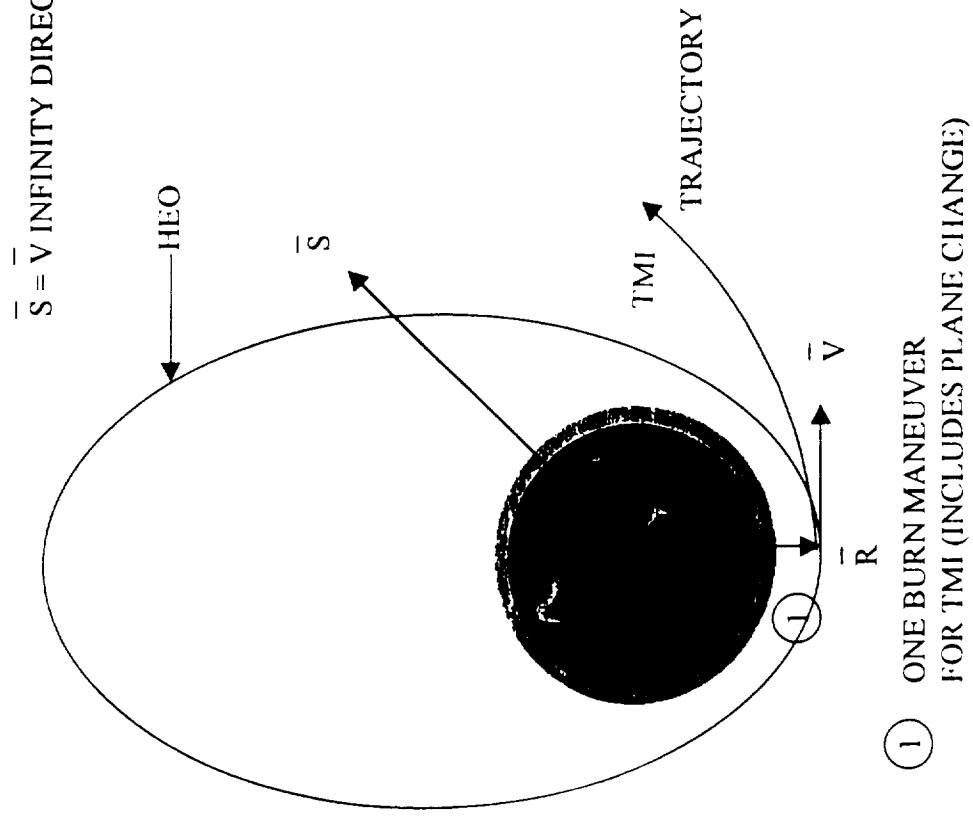
LAUNCH WINDOW FROM A HIGH ELLIPTICAL ORBIT (HEO)

The duration of a planetary launch window depends on the orbital dynamic change between the orbit plane and outgoing asymptote vector (\vec{S}) and the hyperbolic energy level required for the earth's Trans-Mars injection (TMI). The parameters that affect the orbital launch window include the parking orbit inclination, perigee altitude, apogee altitude, and the declination and right ascension of the outgoing asymptote vector (\vec{S}).

This chart shows the orbital geometry for a one burn maneuver and a two burn maneuver to achieve TMI from a High Elliptical Orbit (HEO). When the angle between the orbit plane and the outgoing asymptote vector (\vec{S}) is small, the TMI may be made efficiently with a single burn maneuver. The single burn maneuver will include an orbit energy change combined with a plane change. When the angle between the orbit plane and \vec{S} is large, however, the Δv requirement can be prohibitively large. Thus a more efficient means of attaining TMI is desired. This can be achieved by dividing the TMI maneuver into two burns. The first burn maneuver is made near the HEO apogee, at point (1), which change the HEO plane to contain the outgoing asymptote vector, creating an inplane maneuver for the second burn near HEO perigee, at point (2) to complete TMI.

Both the single burn maneuver and two burn maneuver results need to be determined across the duration of the launch window to identify which is the more efficient on a given day.

LAUNCH WINDOW FROM A HIGH ELLIPTICAL ORBIT (HEO)



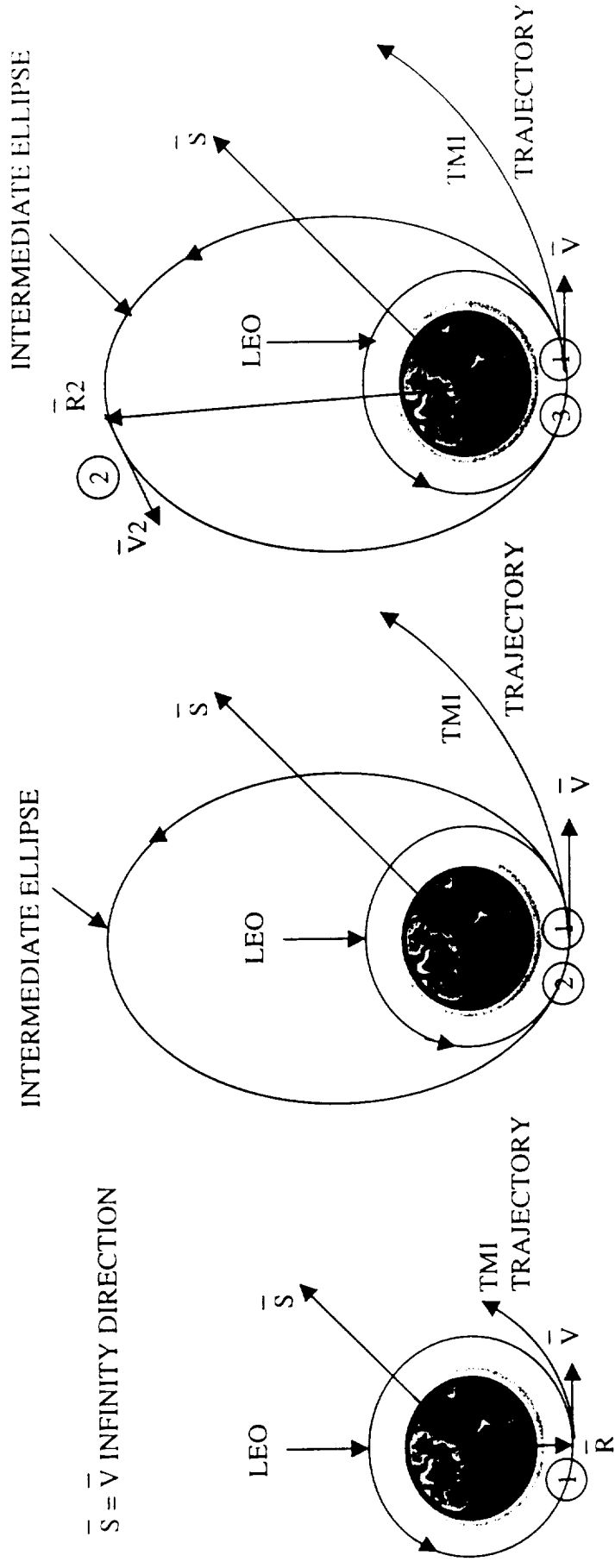
LAUNCH WINDOW FROM LOW EARTH ORBIT (LEO)

This chart shows the orbital geometry for a one, two and three burn maneuver to achieve Trans-Mars Injection (TMI). The one burn maneuver, which includes an orbit energy change combined with a plane change, is made near the LEO perigee. When the thrust to initial weight ratio is relatively high (≥ 0.6) and the required plane change angle is small ($\leq 3.0^\circ$) the one burn maneuver would be efficient to achieve TMI. When the thrust to initial weight ratio is relatively low (≤ 0.25) and the required plane change is low ($\leq 3.0^\circ$) the two burn maneuver would be more efficient than the one burn maneuver because the gravity loss would be considerably lower. The first burn would place the Mars' vehicle into an intermediate ellipse (~ 4.8 hr period) where the vehicle would coast one orbit back near perigee (at point (2)). At this point the second burn is made which includes an orbit energy change and a plane change to achieve TMI.

The three burn maneuver for TMI may be more efficient when the thrust to initial weight ratio is low (≤ 0.25) and the required plane change is greater than three degrees. The first burn places the Mars vehicle into an intermediate ellipse (~ 4.8 hr period). The vehicle coasts to just past apogee of the intermediate ellipse where a second burn is made to change the intermediate orbit plane to contain the outgoing asymptote vector (S^-). After the second burn the vehicle coasts back to near perigee where the third burn, inplane, maneuver is made to achieve TMI.

The results from all three different types of burn maneuvers need to be determined across the duration of the launch window to identify which is the most efficient on a given day.

LAUNCH WINDOW FROM LOW EARTH ORBIT (LEO)



- 1 ONE BURN MANEUVER FOR TMI (INCLUDES PLANE CHANGE)

- 1 BURN INTO INTERMEDIATE ELLIPSE (~ 4.8 HR PERIOD)
- 2 TMI BURN (INCLUDES PLANE CHANGE)

- 1 BURN INTO INTERMEDIATE ELLIPSE (~ 4.8 HR PERIOD)
- 2 PLANE CHANGE BURN
- 3 TMI BURN

Total: 5,000.00 00 00

Time	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	100.580	6.000	18.263	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305	
2	45.305	6.300	9.245	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.000	

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	V Loss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	V Loss (m/s)
1	3.07510	-10.15	169.52	12.564	0.91057	12.521	5.45117	-6.97	314.16	0.000	0.00000	0.000
2	2.79973	-22.29	160.17	6.068	0.97501	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period days
67	1.2579239	0.219942932	1.23779	281.99267	171.36358	8.71725	156.81879	0.9812524	1.5345954	515.33354
7	1.3503496	0.287971017	1.65105	107.77939	232.40005	194.26408	307.54150	0.9278682	1.6780310	543.23764

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
300.00000	51.60000	0.91057	-48.07849	115.71342	-0.26395	0.54812	-0.67752
300.00000	51.60000	0.91057	34.12085	128.98116	-0.47318	0.58681	0.51078

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	729.00		919.00
Flight/Stay		200.00		529.00	190.00	
31 Cap Orbits (radial)						
Apoapse Distance	10.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9813			1.0166	
Maximum Heliocentric		1.5004			1.6574	
Geocentric	0.0000		1.1244	1.6764		0.0000

Parameters				
Propulsion Type	Vloss	None	Vloss	None
Winf (km/sec)	3.08	5.45	2.80	6.91
Eff Delta-V (km/sec)	0.91	0.00	0.98	0.00
Vel. Losses (km/sec)	12.52	0.00	2.97	0.00
Propellant (kg or t)	18.26	0.00	9.25	0.00
Burn time (hr)	0.21	0.00	0.10	0.00
Thrust (lbs or klbs)	24.75	0.00	24.75	0.00
Spd Imp (sec)	463.4	0.0	442.1	0.0
Mass Changes (kg or t)				
Dry Stage Jettisoned	6.00	0.00	6.30	0.00
Probes Separated		17.31		23.56
AeroBrake Separated		13.10		0.00
Drop Mass Left		0.00		0.00
Sample Mass Added		0.00		0.00

PERFORMANCE SUMMARY

Leg	From	Depart	Arrive	Flight Time (hr)	
1	Earth	JAN 3, 2014, 12.0000 hours GMT Julian Date 56661.0000	Mars	JUL 21, 2014, 19.1249 hours GMT Julian Date 56860.2071	188.207
2	Mars	JAN 1, 2016, 16.8446 hours GMT Julian Date 57399.2019	Earth	JUL 9, 2016, 16.8446 hours GMT Julian Date 57579.2019	180.000
Total Duration					368.207

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Crops	Samples	NetMass
1	43.753	6.000	18.191	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	45.150
2	43.150	6.300	9.092	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.03071	-9.62	169.14	12.514	0.91492	12.491	5.45000	-7.08	314.19	0.000	0.00000	0.000
2	2.79973	22.27	160.20	5.968	0.97492	2.872	6.81901	15.54	84.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.0375872	0.220094935	1.21414	282.75585	170.60346	9.47860	156.84119	0.9808766	1.5344978	515.17908
2	1.3028137	0.287955829	1.65118	107.72949	232.45981	194.23112	307.48171	0.9276609	1.6779664	543.15262

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.91492	-47.77069	116.02540	-0.26981	0.55257	-0.67746
800.00000	51.60000	0.91492	34.47833	128.43679	-0.46885	0.59077	0.51793

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Earth Helio	Earth Arr
Times (days)						
Depart-Arrive	0.00		199.30	728.20		918.20
Flight/Stay		199.30	528.90		190.00	
Asp/Dep Distts (radial)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9833			1.0166	
Maximum Heliocentric		1.5004			1.6574	
Geocentric	0.0000		1.1247	1.6769		0.0000
Maneuvers						
Propulsion Type	Vloss	None	Vloss	None		
Vinf (km/sec)	3.09		5.45	2.80		6.82
Eff Delta-V (km/sec)	0.91	0.00	0.00	0.97	0.00	0.00
Vel Losses (m/sec)	12.49		0.00	2.87		0.00
Propellant (kg or t)	18.19	0.00	0.00	9.09	0.00	0.00
Burn time (hr)	0.21		0.00	0.10		0.00
Thrust (lbf or kN)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry State Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

PERFORMANCE SUMMARY

Leg	Start Time (yy)	Depart	Arrive	Flight/Stay (yy)
		Earth	Mars	
		JAN 1, 2011, 12.0000 hours GMT Julian Date 56662.0000	MAR 11, 2011, 14.0000 hours GMT Julian Date 56750.0000	
504-3042		Mars	Earth	
		JAN 1, 2016, 18.1008 hours GMT Julian Date 57389.2542	MAR 1, 2016, 18.1008 hours GMT Julian Date 57579.1542	
Total Duration 4100.000				

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell Tankage	Arrive Engine Propell Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	100.837	6.000	18.520 0.000	0.000 0.000 0.000	0.600	17.312	13.100	0.000	0.000	46.303
2	45.905	6.300	9.245 0.000	0.000 0.000 0.000	0.600	23.560	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.11432	-8.92	168.66	12.741	0.92216	13.062	5.45214	-7.24	314.24	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period days
1	1.2574544	0.220382343	1.18160	283.77331	169.59606	10.48779	156.83292	0.9803336	1.5345751	515.03508
2	1.3029496	0.287871025	1.65105	107.77940	232.40002	194.26408	307.54150	0.9279682	1.6780311	543.23766

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.92216	-47.33333	116.49330	-0.27880	0.55935	-0.67807
800.00000	51.60000	0.92216	34.93604	127.89596	-0.46435	0.59657	0.52809

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth Arr
Times (days)							
Depart/Arrive	0.00		198.30	727.25		917.25	
Flight/Stay		198.30		529.95	190.00		
Esc/Cap Orbits (radii)							
Apoapse Distance	12.09		0.00	10.95		0.00	
Periapse Distance	1.13		0.00	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		0.9833		1.0166			
Maximum Heliocentric		1.5004		1.6574			
Geocentric	0.0000		1.1247	1.6764		0.0000	
Maneuvers							
Propulsion Type	Vloss		None	Vloss		None	
Vinf (km/sec)	3.11		5.45	2.80		6.81	
Eff Delta-V (km/sec)	0.92	0.00	0.00	0.98	0.00	0.00	
Vel Losses (m/sec)	13.06		0.00	2.97		0.00	
Propellant (kg or t)	18.52	0.00	0.00	9.25	0.00	0.00	
Burn time (hr)	0.21		0.00	0.10		0.00	
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00	
Spec Imp (sec)	463.4		0.0	442.1		0.0	
Mass Changes (kg or t)							
Dry Stage Jettisoned	6.00		0.00	6.30		0.00	
Probes Separated				17.31		23.56	
AeroBrake Separated				13.10		0.00	
Drop Mass Left				0.00		0.00	
Sample Mass Added				0.00		0.00	

PERFORMANCE SUMMARY

Launch	Impact	Arrival	Flight Summary
Earth	Mars	Mars	Earth
JAN 07, 2014, 12:0000 hours GMT Julian Date 56664.0000	JAN 07, 2014, 12:0000 hours GMT Julian Date 56664.0000	JUL 09, 2016, 14:1004 hours GMT Julian Date 57389.2542	196.40
Earth	Mars	Earth	196.40
JAN 07, 2014, 12:0000 hours GMT Julian Date 56664.0000	JAN 07, 2014, 12:0000 hours GMT Julian Date 56664.0000	JUL 09, 2016, 14:1004 hours GMT Julian Date 57389.2542	196.40
Total Duration			196.40

SPACECRAFT MASS SUMMARY (kg or lb)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	101.207	6.000	18.890	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.305	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.16979	-7.60	167.66	12.995	0.93882	13.868	5.45048	-7.51	314.30	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure	Arrival	Perihelion (AU)	Aphelion (AU)	Period (days)
						True Anom (deg)	True Anom (deg)			
1	1.2566927	0.220917529	1.12652	285.80874	167.53580	12.55104	156.91190	0.9790672	1.5343181	514.56714
2	1.3029497	0.287871033	1.65105	107.77940	232.39999	194.26409	307.54151	0.9278682	1.6780312	543.23769

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.93882	-46.42066	117.32931	-0.29712	0.57494	-0.68010
800.00000	51.60000	0.93882	35.71852	126.84909	-0.45711	0.60994	0.54909

MISSION OPERATIONS

	Earth			Mars			Earth		
	Dep	Helio	Arr	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		196.40	725.25		915.25			
Flight/Stay		196.40		528.85	190.00				
Space Orbits (radii)									
Apocapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		0.9833			1.0166				
Maximum Heliocentric		1.5002			1.6574				
Geocentric	0.0000		1.1253	1.6764		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	3.17		5.45	2.80		6.81			
Eff Delta-V (km/sec)	0.94	0.00	0.00	0.98	0.00	0.00			
Vel Losses (m/sec)	13.87		0.00	2.97		0.00			
Propellant (kg or lb)	18.89	0.00	0.00	9.25	0.00	0.00			
Burn time (hr)	0.22		0.00	0.10		0.00			
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or lb)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

PERFORMANCE SUMMARY

Leg	Depart	Arrive	Flight Time
1	Earth JAN 9, 2014, 12:00:00 hours GMT Julian Date 56666.0000	Mars JUL 22, 2014, 12:00:00 hours GMT Julian Date 56999.0000	194.50
2	Mars JAN 1, 2016, 14:00:00 hours GMT Julian Date 57389.2512	Earth JUL 9, 2016, 14:00:00 hours GMT Julian Date 57722.2512	190.00
Total Duration			384.50

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	ProPELL	Tankage	Engine	ProPELL	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	101.664	6.000	19.347	0.000	0.000	0.000	0.000	0.600	17.310	13.100	0.000	0.000	41.000
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)
1	3.23659	-6.35	166.70	13.310	0.95928	14.908	5.44861	-7.77	314.32	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis	Eccentricity	Inclination	Asc Node	Arg Per	Departure	Arrival	Perihelion	Aphelion	Period
	(AU)		(deg)	(deg)	(deg)	True Anom	True Anom	(AU)	(AU)	(days)
1	1.2557727	0.221544971	1.07780	287.84439	165.44233	14.64717	157.02385	0.9775625	1.5339828	514.00019
2	1.3029497	0.287871042	1.65105	107.77941	232.39996	194.26409	307.54152	0.9278682	1.6780312	543.23771

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude	Inclination	Delta V	Declination	Rt Ascension	X Dot	Y Dot	Z Dot
(km)	(deg)	(km/sec)	(deg)	(deg)	(km/sec)	(km/sec)	(km/sec)
800.00000	51.60000	0.95928	-45.44157	118.16170	-0.31766	0.59339	-0.68352
800.00000	51.60000	0.95928	36.36177	125.93619	-0.45337	0.62547	0.56974

MISSION OPERATIONS

	Earth		Mars		Earth	
	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)						
Depart/Arrive	0.00		194.50	723.25		913.25
Flight/Stay		194.50		528.75	190.00	
Orbit Data						
Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9834			1.0166	
Maximum Heliocentric		1.5001			1.6574	
Geocentric	0.0000		1.1260		1.6764	0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.24		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.96	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	14.91		0.00	2.97		0.00
Propellant (kg or t)	19.35	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.22		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

PERFORMANCE SUMMARY

Launch Date	Depart	Arrive	Flight Duration
	Earth	Mars	
	JAN 10, 2014, 12:00:00 hours GMT Julian Date = 56668.0000	MAR 20, 2014, 00:41:00 hours GMT Julian Date = 57333.6841	513.33648
	Mars	Earth	
	JAN 10, 2014, 12:00:00 hours GMT Julian Date = 56668.0000	MAR 20, 2014, 00:41:00 hours GMT Julian Date = 57333.6841	513.33648

Data Source: Mission Data

SPACECRAFT MASS SUMMARY (kg or lb)

	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Sampled	NetMass
kg													
1	102.212	6.000	19.895	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.205
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

	Depart						Arrive						
Deg	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	
1	3.31449	-5.19	165.79	13.687	0.98372	16.223	5.44649	-8.02	314.31	0.000	0.00000	0.000	
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	94.03	0.000	0.00000	0.000	

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

	Semi-Axis	Eccentricity	Inclination	Asc Node	Arg Per	Departure	Arrival	Perihelion	Aphelion	Period
	(AU)		(deg)	(deg)	(deg)	True Anom	True Anom	(AU)	(AU)	Days
						(deg)	(deg)			
1	1.2546882	0.222271418	1.03452	289.98018	163.31543	16.77637	157.16907	0.9758068	1.5335695	513.33648
2	1.3029498	0.287871051	1.65105	107.77942	232.39993	194.26410	307.54152	0.9278682	1.6780313	543.23774

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude	Inclination	Delta V	Declination	Rt Ascension	X Dot	Y Dot	Z Dot
(km)	(deg)	(km/sec)	(deg)	(deg)	(km/sec)	(km/sec)	(km/sec)
900.00000	51.60000	0.98372	-44.40399	118.99913	-0.34071	0.61468	-0.68832
900.00000	51.60000	0.98372	36.87292	125.17865	-0.45338	0.64322	0.59027

MISSION OPERATIONS

	Earth		Mars		Earth
	Dep	Helio	Arr	Dep	Helio
Days					
Depart/Arrive	0.00		192.60	721.25	911.25
Flight/Stay		192.60		528.65	190.00
Orb Cap Orbits (radial)					
Apoapse Distance	12.09		0.00	10.95	0.00
Periapse Distance	1.13		0.00	1.07	0.00
Spacecraft Distances (AU)					
Minimum Heliocentric		0.9834		1.0166	
Maximum Heliocentric		1.5000		1.6574	
Geocentric	0.0000		1.1266	1.6764	0.0000
Maneuvers					
Propulsion Type	Vloss		None	Vloss	None
Vinf (km/sec)	3.31		5.45	2.80	6.81
Diff Delta-V (km/sec)	0.98	0.00	0.00	0.98	0.00
Vel Losses (m/sec)	16.22		0.00	2.97	0.00
Propellant (kg or lb)	19.89	0.00	0.00	9.25	0.00
Burn time (hr)	0.23		0.00	0.10	0.00
Thrust (lbs or kilos)	24.75		0.00	24.75	0.00
Spd Imp (sec)	463.4		0.0	442.1	0.0
Mass Changes (kg or lb)					
Dry Stage Jettisoned	6.00		0.00	6.30	0.00
Probes Separated			17.31		23.56
AeroBrake Separated			13.10		0.00
Drop Mass Left			0.00		0.00
Sample Mass Added			0.00		0.00

PERFORMANCE SUMMARY

Leg	Depart	Arrival	Duration
1	Earth JAN 10, 2014, 10:00:00 hours GMT Julian Date = 55670.0000	Mars JUL 22, 2014, 14:00:00 hours GMT Julian Date = 56600.0000	184.0000
2	Mars JAN 1, 2016, 14:00:00 hours GMT Julian Date = 57389.2541	Earth JUL 3, 2016, 14:00:00 hours GMT Julian Date = 57574.2541	184.0000
Total Duration			368.0000

SPACECRAFT MASS SUMMARY (kg or lb)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	102.859	6.000	20.542	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.308
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.300

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)
1	3.40356	-4.10	164.99	14.132	1.01242	17.872	5.45055	-8.27	314.28	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis	Eccentricity	Inclination	Asc Node	Arg Per	Departure	Arrival	Perihelion	Aphelion	Period
	(AU)		(deg)	(deg)	(deg)	True Anom	True Anom	(AU)	(AU)	(days)
1	1.2536313	0.223211351	0.99241	291.91572	161.17844	18.91564	157.27082	0.9738065	1.5334560	510.68800
2	1.3029498	0.287871059	1.65105	107.77943	232.39990	194.26411	307.54153	0.9278683	1.6780313	543.23776

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude	Inclination	Delta V	Declination	Rt Ascension	X Dot	Y Dot	Z Dot
(km)	(deg)	(km/sec)	(deg)	(deg)	(km/sec)	(km/sec)	(km/sec)
800.00000	51.60000	1.01242	-43.30342	119.91316	-0.36742	0.63862	-0.63438
800.00000	51.60000	1.01242	37.27075	124.63584	-0.45791	0.66299	0.61310

MISSION OPERATIONS

	Earth	Earth	Mars	Earth
	Dep	Helio	Arr	Dep
Times (days)				
Depart/Arrive	0.00		190.60	719.25
Flight/Stay		190.60	528.65	190.00
Apogee Distance (km)	12.09		0.00	10.95
Periapse Distance	1.13		0.00	1.07
Spacecraft Distances (AU)				
Minimum Heliocentric		0.9835		1.0166
Maximum Heliocentric		1.5000		1.6574
Geocentric	0.0000		1.1266	1.6764
				0.0000
Maneuvers				
Propulsion Type	Vloss		None	Vloss
Vinf (km/sec)	3.40		5.45	2.80
Eff Delta-V (km/sec)	1.01	0.00	0.00	0.98
Vel Losses (m/sec)	17.87		0.00	2.97
Propellant (kg or lb)	20.54	0.00	0.00	9.25
Burn time (hr)	0.24		0.00	0.10
Thrust (lbs or klbs)	24.75		0.00	24.75
Spec Imp (sec)	463.4		0.0	442.1
Mass Changes (kg or lb)				
Dry Stage Jettisoned	6.00		0.00	6.30
Probes Separated				17.31
AeroBrake Separated				13.10
Drop Mass Left				0.00
Sample Mass Added				0.00

PERFORMANCE SUMMARY

Leg	Start Time	Depart	Arrive	End Time
1	14700	Earth	Mars	14700
		JAN 13, 2014, 12:0000 hours GMT Julian Date = 55671.0000	MAR 22, 2014, 00:4000 hours GMT Julian Date = 56610.6667	14700
2	14700	Mars	Earth	14700
		JAN 17, 2016, 18:0000 hours GMT Julian Date = 57389.2500	MAR 19, 2016, 18:0000 hours GMT Julian Date = 57590.5000	14700
Total Duration = 14700				

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Proces	AeroBrk	Drops	Samples	NetMass
1	103.222	6.000	20.904	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	43.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)
1	3.45207	-3.58	164.61	14.381	1.02839	18.842	5.45253	-8.40	314.25	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis	Eccentricity	Inclination	Asc Node	Arg Per	Departure	Arrival	Perihelion	Aphelion	Period
	(AU)		(deg)	(deg)	(deg)	True Anom	True Anom	(AU)	(AU)	Days
1	1.2530376	0.223722760	0.97306	292.93350	160.09755	19.99753	157.33408	0.9727046	1.5333707	510.20389
2	1.3029498	0.287971064	1.65105	107.77943	232.39989	194.26411	307.54153	0.9278693	1.6780314	543.03779

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude	Inclination	Delta V	Declination	Rt Ascension	X Dot	Y Dot	Z Dot
(km)	(deg)	(km/sec)	(deg)	(deg)	(km/sec)	(km/sec)	(km/sec)
900.00000	51.60000	1.02839	-42.73784	120.37302	-0.38191	0.65165	-0.69791
900.00000	51.60000	1.02839	37.42331	124.43079	-0.46178	0.67363	0.62495

MISSION OPERATIONS

	Earth		Mars		Earth
	Dep	Helio	Arr	Dep	Helio
Times (days)					
Depart/Arrive	0.00		189.60	718.25	908.25
Flight/Stay		189.60		529.65	190.00
Isr/Cap Orbits (radial)					
Apoapse Distance	12.09		0.00	10.95	0.00
Periapse Distance	1.13		0.00	1.07	0.00
Spacecraft Distances (AU)					
Minimum Heliocentric		0.9835		1.0166	
Maximum Heliocentric		1.5000		1.6574	
Geocentric	0.0000		1.1266	1.6764	0.0000
Maneuvers					
Propulsion Type	Vloss		None	Vloss	None
Vinf (km/sec)	3.45		5.45	2.80	6.81
Eff Delta-V (km/sec)	1.03	0.00	0.00	0.98	0.00
Vel Losses (m/sec)	18.84		0.00	2.97	0.00
Propellant (kg or t)	20.90	0.00	0.00	9.25	0.00
Burn time (hr)	0.24		0.00	0.10	0.00
Thrust (lbs or klbs)	24.75		0.00	24.75	0.00
Spec Imp (sec)	463.4		0.0	442.1	0.0
Mass Changes (kg or t)					
Dry Stage Jettisoned	6.00		0.00	6.30	0.00
Probes Separated			17.31		23.56
AeroBrake Separated			13.10		0.00
Drop Mass Left			0.00		0.00
Sample Mass Added			0.00		0.00

Run Date	Report	Archive	Run Date
Batch	JAN 01, 2014, 18:00:00 hours GMT Callian Date = 96670.0000	March	JUL 02, 2014, 18:00:00 hours GMT Callian Date = 100000.00
Batch	JAN 01, 2014, 18:00:00 hours GMT Callian Date = 97000.0000	Batch	JUL 02, 2014, 18:00:00 hours GMT Callian Date = 100000.00
Total Duration:			00:00:00

SPACECRAFT MASS SUMMARY (kg or t)

Seq	Initial	Depart			Arrive			Inert	Process	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	103.608	6.000	21.291	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.000	
2	45.905	6.300	9.245	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	5.000	

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.50288	-3.10	164.21	14.648	1.04539	19.915	5.44795	-8.51	314.20	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period days
1.0521398	0.224156824	0.95804	293.95159	158.98470	21.11096	157.48277	0.9715107	1.5329889	511.81011
1.3029498	0.287871068	1.65105	107.77944	232.39987	194.26411	307.54154	0.9278683	1.6780314	543.23779

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
900.00000	51.60000	1.04539	-42.17536	120.77749	-0.39643	0.66562	-0.70188
900.00000	51.60000	1.04539	37.53574	124.22976	-0.46620	0.68538	-0.63691

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart-Arrive	0.00		188.70		717.25	907.25
Flight Stay		188.70		523.55	190.00	
ap Cap Orbits (radial)						
Apoapse Distance	12.09		0.00		10.95	0.00
Periapse Distance	1.13		0.00		1.07	0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9836			1.0166	
Maximum Heliocentric		1.4999			1.6574	
Geocentric	0.0000		1.1273		1.6764	0.0000
Maneuvers						
Propulsion Type	Vloss		None		Vloss	None
Wt (km/sec)	3.50		5.45		2.80	6.81
Wt Delta-V (km/sec)	1.05	0.00	0.00		0.98	0.00
Wt Losses (m/sec)	19.91		0.00		2.97	0.00
Propellant (kg or t)	21.29	0.00	0.00		9.25	0.00
Burn time (hrs)	0.24		0.00		0.10	0.00
Thrust (lbs or kips)	24.75		0.00		24.75	0.00
Spd Imp (sec)	463.4		0.0		442.1	0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00		6.30	0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Pro Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

PERFORMANCE SUMMARY

Leg	Start	Arrive	Flight Time
1	Earth Date: JAN 14, 2016, 14:0000 hours GMT Julian Date: 56711.000	Mars Date: MAR 27, 2016, 14:0000 hours GMT Julian Date: 57389.000	186.80
2	Mars Date: JAN 17, 2016, 14:0000 hours GMT Julian Date: 57389.000	Earth Date: MAR 4, 2016, 14:0000 hours GMT Julian Date: 57570.2541	190.00
Total Duration			376.80

SPACECRAFT MASS SUMMARY (kg or lb)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	104.469	6.000	22.152	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.305	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.61254	-2.19	163.51	15.240	1.08299	22.447	5.44513	-8.74	314.08	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure	Arrival	Perihelion (AU)	Aphelion (AU)	Period days
						True Anom (deg)	True Anom (deg)			
1	1.2505849	0.225224555	0.92720	295.98738	156.75754	23.33931	157.72921	0.9689225	1.5322473	510.80037
2	1.3029499	0.287871077	1.65105	107.77944	232.39984	194.26412	307.54154	0.9278683	1.6780315	543.00781

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
900.00000	51.60000	1.08299	-41.01428	121.66776	-0.42901	0.69550	-0.71071
800.00000	51.60000	1.08299	37.68813	124.01133	-0.47939	0.71041	0.66210

MISSION OPERATIONS

	Earth			Mars			Earth		
	Dep	Helio	Arr	Dep	Helio	Arr	Dep	Helio	Arr
Days									
Depart/Arrive	0.00		186.80	715.25		905.25			
Flight/Stay		186.80		528.45		190.00			
Dep Orbits (radial)									
Approach Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		0.9837		1.0166					
Maximum Heliocentric		1.4997		1.6574					
Eccentricity	0.0000		1.1279	1.6764		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	3.61		5.45	2.80		6.81			
Rt Delta-V (km/sec)	1.08	0.00	0.00	0.98	0.00	0.00			
Vel Losses (m/sec)	22.45		0.00	2.97		0.00			
Propellant (kg or lb)	22.15	0.00	0.00	9.25	0.00	0.00			
Burn time (hr)	0.25		0.00	0.10		0.00			
Thrust (lbf or kN)	24.75		0.00	24.75		0.00			
Imp (lbf-sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or lb)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

Leg	From	To	Depart Date	Arrival Date
1	Earth	Mars	JAN 14, 2014, 10:00:00 hours GMT Julian Date = 56576.0000	MAR 22, 2014, 10:00:00 hours GMT Julian Date = 56916.0000
2	Mars	Earth	JAN 14, 2016, 10:00:00 hours GMT Julian Date = 57399.2541	JUL 9, 2016, 10:00:00 hours GMT Julian Date = 57740.0000

Total Duration = 1,000 days

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	105.434	6.000	23.137	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.805
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.210

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)
1	3.73250	-1.35	162.93	15.917	1.12562	25.594	5.44872	-8.99	313.94	0.000	0.00000	0.000
2	2.73974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis	Eccentricity	Inclination	Asc Node	Arg Per	Departure	Arrival	Perihelion	Aphelion	Period
	(AU)		(deg)	(deg)	(deg)	True Anom	True Anom	(AU)	(AU)	days
1	1.12489907	0.226526814	0.89649	298.02269	154.52121	25.57676	157.92946	0.9660531	1.5319084	509.83781
2	1.10023499	0.287871085	1.65105	107.77945	232.39982	194.26412	307.54155	0.9278683	1.6790315	543.23784

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude	Inclination	Delta V	Declination	Rt Ascension	X Dot	Y Dot	Z Dot
(km)	(deg)	(km/sec)	(deg)	(deg)	(km/sec)	(km/sec)	(km/sec)
800.00000	51.60000	1.12562	-39.81821	122.63855	-0.46629	0.72804	-0.72079
800.00000	51.60000	1.12562	37.74185	124.01881	-0.49799	0.73777	0.68900

1,1000 NO S-LOSSES

MISSION OPERATIONS

	Earth	Helio	Mars	Earth
	Dep	Helio	Arr	Dep
Mission Days				
Depart/Arrive	0.00	184.90	713.25	903.25
Flight Stay		184.90	529.45	190.00

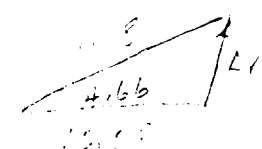
	Earth	Mars	Earth
	Dep	Arr	Dep
Drop Distance (radial)			
Reapase Distance	12.09	0.00	10.95
Periapase Distance	1.13	0.00	1.07

Spacecraft Distances (AU)	Earth	Mars	Earth
	Dep	Arr	Dep
Minimum Heliocentric	0.9839		1.0166
Maximum Heliocentric	1.4997		1.6574
Geocentric	0.0000	1.1279	1.6764

Impovers	Earth	Mars	Earth
	Dep	Arr	Dep
Propulsion Type	Vloss	None	Vloss
Vinf (km/sec)	3.73	5.45	2.80
Eff Delta-V (km/sec)	1.13	0.00	0.99
Vel Losses (m/sec)	25.59	0.00	2.97
Propellant (kg or t)	23.14	0.00	9.25
Burn Time (hrs)	0.27	0.00	0.10
Thrust (lbs or klbs)	24.75	0.00	24.75
Spec Imp (sec)	463.4	0.0	442.1

Mass Changes (kg or t)	Earth	Mars	Earth
	Dep	Arr	Dep
Drop Stage Detached	6.00	0.00	6.30
Probes Separated			17.31
AeroBrake Separated			13.10
Drop Mass Left			0.00
Sample Mass Added			0.00

ΔV
 $W_{S \rightarrow M} = 0.996694$
 $W_{M \rightarrow E} = 4.1000$



$$\Delta V^2 = 226.5988^2 - 224.6427^2$$

$$\Delta V = 1398 \text{ m/sec}$$

PERFORMANCE SUMMARY

Stay Time (days)	Depart	Arrive	Flight Time (days)
	Earth JAN 20, 2014, 12.0000 hours GMT Julian Date 56678.0000	Mars JUL 22, 2014, 9.6000 hours GMT Julian Date 56860.9000	182.9000
909.2540	Mars JAN 1, 2016, 18.0971 hours GMT Julian Date 57389.2540	Earth JUL 9, 2016, 18.0971 hours GMT Julian Date 57579.2540	180.0000
Total Duration			901.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	106.569	6.000	24.251	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.935	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	3.86198	-0.59	162.40	16.684	1.17341	29.494	5.44568	-9.22	313.76	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2469806	0.227864616	0.87164	300.05809	152.22833	27.87007	158.24099	0.9628379	1.5311234	508.61360
2	1.3029500	0.287871094	1.65105	107.77946	232.39979	194.26413	307.54156	0.9278683	1.6780316	543.23786

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
900.00000	51.60000	1.17341	-38.61558	123.59062	-0.50725	0.76374	-0.73231
800.00000	51.60000	1.17341	37.68590	124.17185	-0.52158	0.76829	0.71734

1147.9 No 5-Losses
MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Earth Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		182.90	711.25		901.25
Flight/Stay		182.90		528.35	190.00	
Esoc/Coq Orbits (radial)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9840		1.0166		
Maximum Heliocentric		1.4996		1.6574		
Geocentric	0.0000		1.1286	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss	None	Vloss	None		
Vinf (km/sec)	3.86		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.17	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	29.49		0.00	2.97		0.00
Propellant (kg or t)	24.25	0.00	0.00	9.25	0.00	0.00
Burn time (sec)	0.28		0.00	0.10		0.00
Thrust (lbf or klbf)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

$C = 1.26859$
 $R_A = 1.021$
 $R_A = 1.021$
 $L_{00} = 1.021$

1.021

1.021

1.021

$V_F = 1.2339$

1.021
 2.70
 1.021

Day Time (days)	Depart	Arrive	Flight Time (days)
	Earth JAN 21, 2014, 12.0000 hours GMT Julian Date 56679.0000	Mars JUL 22, 2014, 9.6000 hours GMT Julian Date 56860.0000	181.0000
609.3510	Mars JAN 1, 2016, 18.0969 hours GMT Julian Date 57389.2540	Earth JUL 9, 2016, 18.0969 hours GMT Julian Date 57579.2540	190.0000
	Total Duration		300.2540

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	107.181	6.000	24.864	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	V Loss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	V Loss (m/s)
1	3.93042	-0.24	162.18	17.105	1.19944	31.793	5.44747	-9.34	313.66	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2460055	0.228639907	0.85877	301.07552	151.08183	29.01679	158.37017	0.9611189	1.5308921	508.01713
2	1.3029500	0.287871098	1.65105	107.77946	232.39977	194.26413	307.54156	0.9279683	1.6780316	543.03799

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
900.00000	51.60000	1.19944	-38.00544	124.10285	-0.52990	0.78258	-0.73854
900.00000	51.60000	1.19944	37.62524	124.33308	-0.53579	0.78447	0.73225

	Earth		Mars		Earth	
	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)						
Depart/Arrive	0.00		181.90	710.25		900.25
Flight/Stay		181.90		528.35	190.00	

Apocaps Distance	12.09	0.00	10.95	0.00
Periapoc Distance	1.13	0.00	1.07	0.00

Spacecraft Distances (AU)					
Minimum Heliocentric	0.9841			1.0166	
Maximum Heliocentric	1.4996			1.6574	
Geocentric	0.0000	1.1286	1.6764		0.0000

Maneuvers		None		None	
Propulsion Type	Vloss			Vloss	None
Vinf (km/sec)	3.93		5.45	2.80	6.81
Eff Delta-V (km/sec)	1.20	0.00	0.00	0.98	0.00
Vel Losses (m/sec)	31.79		0.00	2.97	0.00
Propellant (kg or t)	24.86	0.00	0.00	9.25	0.00
Burn time (hr)	0.29		0.00	0.10	0.00
Thrust (lbs or klbs)	24.75		0.00	24.75	0.00
Spd Imp (sec)	463.4		0.0	442.1	0.0

Mass Changes (kg or t)				
Dry Stage Detritus	6.00	0.00	6.30	0.00
Probes Separated		17.31		23.56
HardBrake Separated		13.10		0.00
Drop Mass Left		0.00		0.00
Sample Mass Added		0.00		0.00

X Dot Y Dot Z Dot
 (km/sec) (km/sec) (km/sec)
 -0.52990 0.78259 -0.73854
 -0.53579 0.78447 0.73225

$C_3 = 15.445201$ $a = -2585.1$
 $7.78 = -25800.33 / -$
 $e = .07819$
 $\gamma_h = -1.48^\circ$
 $R_{th} = 162.18$
 160.87
 $1.33 - .064 \dots$

$\Delta V_{21}^M \sim \Delta V_{20}^M = .999033$
 WEDGE = 2.52°

$\Delta V = 225.155 -$
 $\Delta V = 225.155$

File Name: Loaded Date

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
		Earth	Mars	181.0000
		JAN 22, 2014, 12.0000 hours GMT Julian Date 56680.0000	JUL 22, 2014, 12.0000 hours GMT Julian Date 56861.0000	
	528.2540	Mars	Earth	190.0000
		JAN 1, 2016, 18.0967 hours GMT Julian Date 57389.2540	JUL 9, 2016, 19.0967 hours GMT Julian Date 57579.2540	
Total Duration				899.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	107.929	6.000	25.512	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.925	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	2.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.00097	0.08	161.95	17.551	1.22685	34.354	5.44266	-9.45	313.53	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2447786	0.229352802	0.84924	302.09318	149.90336	30.19507	158.58491	0.9592851	1.5302720	507.26699
2	1.3029500	0.287871103	1.65105	107.77947	232.39976	194.26414	307.54156	0.9278683	1.6780317	543.23799

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.22685	-37.40238	124.58070	-0.55315	0.80241	-0.74520
800.00000	51.60000	1.22685	37.53501	124.50295	-0.55108	0.80174	0.74745

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr
Times (days)						
Depart/Arrive	0.00		181.00	709.25		899.25
Flight/Stay		181.00		528.25	190.00	
Asp/Cap Orbits (radial)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9842		1.0166		
Maximum Heliocentric		1.4995		1.6574		
Geocentric	0.0000		1.1292	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.00		5.44	2.80		6.81
Eff Delta-V (km/sec)	1.23	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	34.35		0.00	2.97		0.00
Propellant (kg or t)	25.51	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.29		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

$$\Delta V_{12} = 1.240 \text{ km/sec}$$



$$\Delta V = 1.240 \text{ km/sec}$$

PERFORMANCE SUMMARY

Stay Time (days)	Depart	Arrive	Flight Time (days)
	Earth JAN 23, 2014, 12.0000 hours GMT Julian Date 56881.0000	Mars JUL 22, 2014, 12.0000 hours GMT Julian Date 56861.0000	180.0000
529.2540	Mars JAN 1, 2016, 18.0964 hours GMT Julian Date 57389.2540	Earth JUL 9, 2016, 18.0964 hours GMT Julian Date 57579.2540	190.0000
Total Duration			899.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	108.520	6.000	26.203	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	48.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.07408	0.40	161.78	18.027	1.25588	37.229	5.44450	-9.57	313.42	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2437000	0.230206342	0.83755	303.11043	148.74108	31.35737	158.73004	0.9573924	1.5300077	506.60780
2	1.3029500	0.287871107	1.65105	107.77947	232.39974	194.26414	307.54157	0.9278684	1.6780317	543.23790

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.25588	-36.78965	125.11103	-0.57847	0.82275	-0.75212
800.00000	51.60000	1.25588	37.42859	124.74879	-0.56844	0.81945	0.76329

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth
Times (days)							
Depart/Arrive	0.00		180.00	708.25		898.25	
Flight/Stay		180.00		528.25	190.00		
Isocap Orbits (radial)							
Apoapse Distance	12.09		0.00	10.95		0.00	
Periapse Distance	1.13		0.00	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		0.9843		1.0166			
Maximum Heliocentric		1.4995		1.6574			
Geocentric	0.0000		1.1292	1.6764		0.0000	

Maneuvers	Propulsion Type	Vloss	None	Vloss	None
Vinf (km/sec)	4.07	5.44	2.80	6.81	
Eff Delta-V (km/sec)	1.26	0.00	0.00	0.98	0.00
Vel Losses (m/sec)	37.23	0.00	2.97	0.00	0.00
Propellant (kg or t)	26.20	0.00	9.25	0.00	0.00
Burn time (hr)	0.30	0.00	0.10	0.00	0.00
Thrust (lbs or klbs)	24.75	0.00	24.75	0.00	0.00
Spec Imp (sec)	463.4	0.0	442.1	0.0	

Mass Changes (kg or t)	Dry Stage Jettisoned	Probes Separated	AeroBrake Separated	Drop Mass Left	Sample Mass Added
	6.00	0.00	6.30	0.00	
		17.31	23.56	0.00	
		13.10	0.00	0.00	
		0.00	0.00	0.00	
		0.00	0.00	0.00	

$$AV_{20} \cdot AV_{25} = 0.994813$$

$$WEOG \cdot V = 1.1130$$

$$LV^2 = 379.260 \cdot 227.7375$$

$$AV = 1236$$

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart (days)	Arrive (days)	Flight Time (days)
		Earth	Mars	
		JAN 24, 2014, 12.0000 hours GMT Julian Date 56682.0000	JUL 23, 2014, 12.0000 hours GMT Julian Date 56862.0000	180.0000
527.2540		Mars	Earth	
		JAN 1, 2016, 18.0962 hours GMT Julian Date 57389.2540	JUL 9, 2016, 18.0962 hours GMT Julian Date 57579.2540	190.0000
Total Duration				897.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	109.230	6.000	26.913	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.14704	0.61	161.29	18.515	1.28550	40.342	5.38052	-9.57	313.13	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	16.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2405997	0.230126899	0.85250	304.13058	147.33440	32.76097	159.65548	0.9551043	1.5260951	504.71468
2	1.3029500	0.287871111	1.65105	107.77947	232.39973	194.26414	307.54157	0.9278684	1.6780317	543.23791

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.28550	-36.25913	125.25832	-0.59837	0.84642	-0.76030
800.00000	51.60000	1.28550	37.24309	124.71857	-0.58285	0.84116	0.77798

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr
Times (days)						
Depart/Arrive	0.00		180.00	707.25		897.25
Flight/Stay		180.00		527.25		190.00

Esc/Cap Orbits (radii)	Earth	Mars	Earth
Apoapse Distance	12.09	0.00	10.95
Periapse Distance	1.13	0.00	1.07

Spacecraft Distances (AU)	Earth	Mars	Earth
Minimum Heliocentric	0.9844		1.0166
Maximum Heliocentric	1.4982		1.6574
Geocentric	0.0000	1.1356	1.6764

Maneuvers	Earth	Mars	Earth
Propulsion Type	Vloss	None	Vloss
Vinf (km/sec)	4.15	5.38	2.80
Eff Delta-V (km/sec)	1.29	0.00	0.98
Vel Losses (m/sec)	40.34	0.00	2.97
Propellant (kg or t)	26.91	0.00	9.25
Burn time (hr)	0.31	0.00	0.10
Thrust (lbs or klbs)	24.75	0.00	24.75
Spec Imp (sec)	463.4	0.0	442.1

Mass Changes (kg or t)	Earth	Mars	Earth
Dry Stage Jettisoned	6.00	0.00	6.30
Probes Separated		17.31	23.56
AeroBrake Separated		13.10	0.00
Drop Mass Left		0.00	0.00
Sample Mass Added		0.00	0.00

$$\Delta V_{24} \Delta V_{25} = 0.999955$$

$$\Delta V_{24} \Delta V_{25} = 0.999955$$

$$\Delta V^2 = 229.562 - 225.332$$

$$\Delta V = 1249$$

10:11

Stay Time (days)	Depart	Arrive	Flight Time (days)
	Earth JAN 25, 2014, 12.0000 hours GMT Julian Date 56683.0000	Mars JUL 24, 2014, 12.0000 hours GMT Julian Date 56863.0000	190.0000
826.2540	Mars JAN 1, 2016, 18.0960 hours GMT Julian Date 57389.2540	Earth JUL 9, 2016, 18.0960 hours GMT Julian Date 57579.2540	190.0000
	Total Duration		826.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	109.984	6.000	27.667	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.22230	0.81	160.85	19.034	1.31677	43.831	5.31761	-9.57	312.82	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Reg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2375134	0.230134897	0.86730	305.15042	145.92744	34.16494	160.58244	0.9527183	1.5223084	502.93242
2	1.3029501	0.287871116	1.65105	107.77948	232.39971	194.26415	307.54157	0.9278684	1.6780318	543.23793

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.31677	-35.72819	125.44790	-0.61995	0.87081	-0.76892
800.00000	51.60000	1.31677	37.03756	124.75348	-0.59918	0.86360	0.79314

1.2.79 NO 9-LOSSES

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		180.00	706.25		896.25
Flight/Stay		180.00	526.25		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9845			1.0166	
Maximum Heliocentric		1.4969			1.6574	
Geocentric	0.0000		1.1420	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.22		5.32	2.80		6.81
Eff Delta-V (km/sec)	1.32	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	43.83		0.00	2.97		0.00
Propellant (kg or t)	27.67	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.32		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth JAN 26, 2014, 12.0000 hours GMT Julian Date 56684.0000	Mars JUL 29, 2014, 12.0000 hours GMT Julian Date 56868.0000	184.0000
2	190.0000	Mars JAN 1, 2016, 18.0957 hours GMT Julian Date 57389.2540	Earth JUL 9, 2016, 18.0957 hours GMT Julian Date 57579.2540	190.0000
Total Duration				374.0000

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	110.703	6.000	28.386	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29196	0.57	159.31	19.528	1.34636	47.335	5.01397	-9.05	311.66	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2277061	0.226913880	0.98916	306.17965	143.69927	36.38050	164.49424	0.9491225	1.5062896	436.86688
2	1.3029501	0.287871120	1.65105	107.77948	232.39970	194.26415	307.54158	0.9278684	1.6780318	543.23794

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.34636	-35.58464	124.31120	-0.61720	0.90441	-0.78346
800.00000	51.60000	1.34636	36.50952	123.83572	-0.60256	0.89888	0.80103

1.299 AU S - LOSS

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth
Times (days)							
Depart/Arrive	0.00		184.00	705.25		895.25	
Flight/Stay		184.00		521.25	190.00		
Asc/Cap Orbits (radial)							
Apoapse Distance	12.09		0.00	10.95		0.00	
Periapse Distance	1.13		0.00	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		0.9846		1.0166			
Maximum Heliocentric		1.4904		1.6574			
Geocentric	0.0000		1.1737	1.6764		0.0000	
Maneuvers							
Propulsion Type	Vloss		None	Vloss		None	
Vinf (km/sec)	4.29		5.01	2.80		6.81	
Eff Delta-V (km/sec)	1.35	0.00	0.00	0.98	0.00	0.00	
Vel Losses (m/sec)	47.33		0.00	2.97		0.00	
Propellant (kg or t)	28.39	0.00	0.00	9.25	0.00	0.00	
Burn time (hr)	0.33		0.00	0.10		0.00	
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00	
Spec Imp (sec)	463.4		0.0	442.1		0.0	
Mass Changes (kg or t)							
Dry Stage Jettisoned	6.00		0.00	6.30		0.00	
Probes Separated				17.31		23.56	
AeroBrake Separated				13.10		0.00	
Drop Mass Left				0.00		0.00	
Sample Mass Added				0.00		0.00	

1. Converged.

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
		Earth	Mars	200.0000
		JAN 26, 2014, 16.8000 hours GMT Julian Date 56684.2000	AUG 14, 2014, 16.8000 hours GMT Julian Date 56884.2000	
505.0540		Mars	Earth	190.0000
		JAN 1, 2016, 18.0957 hours GMT Julian Date 57389.2540	JUL 9, 2016, 18.0957 hours GMT Julian Date 57579.2540	
Total Duration				395.0540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	110.681	6.000	28.364	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.28990	-2.18	155.61	19.513	1.34548	47.227	4.24119	-6.53	306.78	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2083607	0.217260067	1.50657	306.41051	141.23863	38.81359	175.67506	0.9458322	1.4708893	455.16930
2	1.3029501	0.287871121	1.65105	107.77948	232.39969	194.26415	307.54158	0.9278684	1.6780318	543.23794

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.34548	-37.81213	119.38488	-0.52157	0.92621	-0.82488
800.00000	51.60000	1.34548	34.24758	121.22146	-0.57650	0.95111	0.75720

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth
Times (days)							
Depart/Arrive	0.00		200.00	705.05		895.05	
Flight/Stay		200.00		505.05	190.00		
Esc/Cap Orbits (radial)							
Apoapse Distance	12.09		0.00	10.95		0.00	
Periapse Distance	1.13		0.00	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		0.9846		1.0166			
Maximum Heliocentric		1.4697		1.6574			
Geocentric	0.0000		1.2733	1.6764		0.0000	
Maneuvers							
Propulsion Type	Vloss		None	Vloss		None	
Vinf (km/sec)	4.29		4.24	2.80		6.81	
Eff Delta-V (km/sec)	1.35	0.00	0.00	0.98	0.00	0.00	
Vel Losses (m/sec)	47.23		0.00	2.97		0.00	
Propellant (kg or t)	28.36	0.00	0.00	9.25	0.00	0.00	
Burn time (hr)	0.33		0.00	0.10		0.00	
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00	
Spec Imp (sec)	463.4		0.0	442.1		0.0	
Mass Changes (kg or t)							
Dry Stage Jettisoned	6.00		0.00	6.30		0.00	
Probes Separated				17.31		23.56	
AeroBrake Separated				13.10		0.00	
Drop Mass Left				0.00		0.00	
Sample Mass Added				0.00		0.00	

PERFORMANCE SUMMARY

Leg	Start Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 8, 2022, 11.9204 hours GMT Julian Date 59830.9592	Mars MAR 27, 2023, 11.0204 hours GMT Julian Date 60030.9592	226.0000
2	915.0067	Mars AUG 23, 2024, 11.9006 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9006 hours GMT Julian Date 60745.9959	200.0000
Total Duration				915.0367

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	101.006	10.500	63.989	0.000	10.119	14.896	0.000	0.000	0.000	0.000	0.000	0.000	63.503
2	63.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29600	44.80	59.80	23.764	1.84618	68.212	3.78554	-19.36	186.20	11.153	1.54222	17.509
2	Burn 2 Coast = 4.60 hrs			24.148	2.36876	150.412	6.26432	-8.06	336.53	0.000	0.00000	0.000
3	3.83794	0.42	29.07	8.322	1.56706	9.952						

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3873974	0.073857472	2.95727	345.46737	358.76193	1.24739	143.50331	1.0074482	1.7673465	536.89747
2	1.1918417	0.033405543	0.32232	170.85059	57.71750	173.15022	302.24574	0.9057634	1.4573201	469.10713

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Per1 (deg)	Asc Node2 (deg)	Arg Per2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
1	2.0107448	0.021387467	37.00000	213.98325	263.35220	338.41046	150.18555	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	44.79961	4.21493	27.19508	0.95873	3.74847	0.06273	1.92632
.5593 .0149 .4570							

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth
Times (days)							
Depart-Arrive	0.00		200.00	715.04		915.04	
Flight Day		200.00		515.04	200.00		
Dep Dep Orbits (radii)							
Apoapse Distance	1.06		10.95	10.95		0.00	
Periapse Distance	1.06		1.07	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		1.0075		0.9935			
Maximum Heliocentric		1.6456		1.4573			
Eccentricity	0.0000		1.4090	1.4798		0.0000	
Maneuvers							
Propulsion Type	Vloss		Vloss	Vloss		None	
Time (km/sec)	4.30		3.79	3.84		6.26	
Eff Delta-V (km/sec)	4.21	0.00	1.54	1.57	0.00	0.00	
Vel Losses (m/sec)	218.62		17.51	9.95		0.00	
Propellant (kg or t)	63.99	0.00	14.90	11.11	0.00	0.00	
Burn time (hr)	0.80		0.19	0.14		0.00	
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00	
Spec Imp (sec)	917.0		917.0	917.0		0.0	
Mass Changes (kg or t)							
Dry Stage Jettisoned	12.50		10.10	0.00		0.00	
Probes Separated				0.00		52.58	
AeroBrake Separated				0.00		0.00	
Up Mass Left				0.00		0.00	
Up Mass Added				0.00		0.00	

PERFORMANCE SUMMARY

Departure Time (days)	Depart	Arrive	Flight Time (days)
100.0000	Earth	Mars	200.0000
	SEP 9, 2022, 12.0000 hours GMT Julian Date 59832.0000		MAR 28, 2023, 12.0000 hours GMT Julian Date 60032.0000
	Mars	Earth	200.0000
	AUG 13, 2024, 11.9005 hours GMT Julian Date 60545.9959		MAR 11, 2025, 11.9005 hours GMT Julian Date 60745.9959
Total Duration			313.9959

SPACECRAFT MASS SUMMARY (kg or t)

ID	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	170.609	10.500	63.840	0.000	10.119	14.647	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss	V Inf	Decl	Rt Asc	Brn Tm	Del V	VLoss
	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)	(km/s)	(deg)	(deg)	(min)	(km/s)	(m/s)
1	4.29871	44.33	58.70	23.710	1.84627	67.916	3.74844	-19.22	186.33	10.967	1.51856	16.615
Burn 2 Coast = 4.60 hrs				24.091	2.36867	149.716						
2	3.83794	3.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Arg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3857809	0.273290302	2.92626	346.47904	357.71749	2.29092	144.00226	1.0070604	1.7645014	595.85459
2	1.3816417	0.233405512	0.32232	170.85059	57.71749	173.15022	302.24574	0.9057634	1.4573201	469.10712

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Arg	Semi-Axis	Eccentricity	Inclination	Asc Node1	Arg Per1	Asc Node2	Arg Per2	Periapse	Apoapse	Period
(deg)	(radii)		(deg)	(deg)	(deg)	(deg)	(deg)	(radii)	(radii)	(hours)
6.1313344	1.4421387467	37.000000	213.88451	263.92616	338.77848	150.23883	1.0735943	10.9478952	24.60638	

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	44.33087	4.21494	26.96392	0.08015	3.75674	0.00526	1.91118

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	714.00		914.00
Flight/Stay		200.00		514.00	200.00	
Earth/Dep Orbits (radius)						
Apoapse Distance	1.06		10.95	10.95		0.00
Periapse Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0072			0.9935	
Maximum Heliocentric		1.6463			1.4573	
Perigee/Heliocentric	0.0000		1.4193	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		Vloss	Vloss		None
Wt/Lt (km/sec)	4.30		3.75	3.84		6.26
Eff Delta-V (km/sec)	4.21	0.00	1.52	1.57	0.00	0.00
Vel Losses (m/sec)	217.63		16.61	9.95		0.00
Propellant (kg or t)	63.84	0.00	14.65	11.11	0.00	0.00
Burn time (hrs)	0.80		0.18	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Stages Separated				0.00		52.58
Air Brake Separated				0.00		0.00
Up Mass Left				0.00		0.00
Down Mass Added				0.00		0.00

PERFORMANCE SUMMARY

Leg	Time (days)	Depart	Arrive	Flight Time (days)
1	10.000	Earth SEP 10, 2022, 12.0000 hours GMT Julian Date 59833.0000	Mars MAR 29, 2023, 12.0000 hours GMT Julian Date 60033.0000	200.0000
		Mars AUG 23, 2024, 11.9004 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9004 hours GMT Julian Date 60745.9959	200.0000
Total Duration				912.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	170.066	12.500	63.732	0.000	10.119	14.412	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart							Arrive						
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)		V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	
1	4.30496	43.86	57.65	23.670	1.84700	67.742		3.71291	-19.08	186.44	10.791	1.49606	15.795	
	Burn 1 Coast =	4.61 hrs		24.049	2.36966	149.306								
2	3.53794	0.42	29.07	8.322	1.56706	9.952		6.26432	-8.06	336.53	0.000	0.00000	0.000	

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Departure					Arrival					Period (days)
	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	True Anom (deg)	True Anom (deg)	Perihelion (AU)	Aphelion (AU)		
1	1.39941900	0.272776903	2.89717	347.45155	356.70365	3.30386	144.49113	1.0066164	1.7617676		594.83008
	1.3995417	0.233405482	0.32232	170.95060	57.71748	173.15022	302.24575	0.9057634	1.4573200		469.10711

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Departure					Arrival					Period (hours)
	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	True Anom (deg)	True Anom (deg)	Periapse (radii)	Apoapse (radii)		
1	6.0107448	0.821387467	37.00000	213.76091	264.49447	339.12667	150.27995	1.0735943	10.9478952		24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	43.86118	4.21666	26.74616	359.28147	3.76522	-0.04722	1.89766

MISSION OPERATIONS

	Earth			Mars			Earth		
	Dep	Helio	Arr	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)									
Depart-Arrive	0.00		200.00	713.00		913.00			
Flight Stay		200.00		513.00		200.00			
Asp Cap Orbits (radii)									
Apoapse Distance	1.06		10.95	10.95		0.00			
Periapse Distance	1.06		1.07	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		1.0070			0.9935				
Maximum Heliocentric		1.6469			1.4573				
Geocentric	0.0000		1.4292	1.4798		0.0000			
Maneuvers									
Propulsion Type	Vloss		Vloss	Vloss		None			
Wind (km/sec)	4.30		3.71	3.84		6.26			
Eff Delta-V (km/sec)	4.22	0.00	1.50	1.57	0.00	0.00			
Vel Losses (m/sec)	217.05		15.80	9.95		0.00			
Propellant (kg or t)	63.73	0.00	14.41	11.11	0.00	0.00			
Burn time (hr)	0.80		0.18	0.14		0.00			
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00			
Spec Imp (sec)	917.0		917.0	917.0		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	12.50		10.12	0.00		0.00			
Probes Separated				0.00		52.58			
AeroBrake Separated				0.00		0.00			
Log Mass Left				0.00		0.00			
Imple Mass Added				0.00		0.00			

PERFORMANCE SUMMARY

Flight Time (days)	Depart	Arrive	Flight Time (days)
100.0000	Earth	Mars	200.0000
	SEP 11, 2022, 12.0000 hours GMT Julian Date 59834.0000	MAR 30, 2023, 12.0000 hours GMT Julian Date 60034.0000	
911.9958	Mars	Earth	200.0000
	AUG 23, 2024, 11.9003 hours GMT Julian Date 60545.9958	MAR 11, 2025, 11.9003 hours GMT Julian Date 60745.9958	
Total Duration			911.9958

SPACECRAFT MASS SUMMARY (kg or t)

Log	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	169.959	12.500	63.657	0.000	10.119	14.179	0.000	0.000	0.000	0.000	0.000	0.000	63.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.31482	43.37	56.63	23.643	1.84835	67.676	3.67749	-18.93	186.54	10.617	1.47380	15.014
2	Burn Coast = 4.61 hrs			24.020	2.37173	149.150						
	3.83794	0.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.5825693	0.212295783	2.86875	348.42459	355.67973	4.32685	144.98922	1.0061008	1.7590358	593.78375
2	1.5825417	0.2133405452	0.32232	170.85060	57.71747	173.15022	302.24576	0.9057634	1.4573200	469.10711

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Orb	Semi-Major Axis	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Peri1 (deg)	Asc Node2 (deg)	Arg Peri2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
1	1.033111	0.000000	0.000000	213.60822	265.07982	339.46967	150.31042	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
100.00000	43.37384	4.22008	26.53275	358.53089	3.77438	-0.09680	1.88515

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Dep	Helio	Earth Arr
Times days:						
Depart/Arrive	0.00		200.00	712.00		912.00
Flight/Stay		200.00		512.00	200.00	
Earth Orbits (radii)						
Apogee Distance	1.06		10.95	10.95		0.00
Perigee Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0067			0.9935	
Maximum Heliocentric		1.6475			1.4573	
Pericenter	0.0000		1.4391	1.4798		0.0000
Miscellaneous						
Propulsion Type	Vloss		Vloss	Vloss		None
Wind (km/sec)	4.31		3.68	3.84		6.26
Eft Delta-V (km/sec)	4.22	0.00	1.47	1.57	0.00	0.00
Vel Losses (m/sec)	216.83		15.01	9.95		0.00
Propellant (kg or t)	63.66	0.00	14.18	11.11	0.00	0.00
Burn time (hr)	0.79		0.18	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Fibres Separated				0.00		52.58
Anti-Brake Separated				0.00		0.00
Cap Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Arrive

SPACECRAFT MASS SUMMARY (kg or t)DEPARTURE/ARRIVAL CONDITIONSHELIOCENTRIC TRANSFER ORBIT ELEMENTSLAUNCH DELTA V ORIENTATION - PLANETOCENTRICMISSION OPERATIONS

	Earth	Mars
	Dep	Arr
Times (days)		
Depart/Arrive	0.00	383.01
Flight/Stay	383.01	
Esc. Cap. Orbits (radial)		
Apoapse Distance	12.09	0.00
Periapse Distance	1.13	0.00
Spacecraft Distances (AU)		
Minimum Heliocentric	1.0053	
Maximum Heliocentric	1.7022	
Geocentric	0.0000	2.5432
Maneuvers		
Propulsion Type	Vloss	None
Winf. (km/sec)	3.71	3.07
Eff. Delta-V (km/sec)	1.11	0.00
Vel. Losses (m/sec)	16.60	0.00
Propellant (kg or t)	18.28	0.00
Burn time (hr)	0.22	0.00
Thrust (lbs or klbs)	24.00	0.00
After Imp. (sec)	461.4	0.0
Mass Changes (kg or t)		
1st Stage Jettisoned	4.40	0.00
Procs. Separated		0.00
AeroBrake Separated		9.80
Drop Mass Left		0.00
Sample Mass Added		0.00

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 2, 2022, 12.0000 hours GMT Julian Date 59825.0000	Mars MAR 21, 2023, 12.0000 hours GMT Julian Date 60025.0000	200.0000
2	500.9959	Mars AUG 23, 2024, 11.9013 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9013 hours GMT Julian Date 60745.9959	200.0000
Total Duration				500.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.573	6.000	31.338	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.923
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.35193	47.04	66.17	21.559	1.38114	59.355	3.99932	-20.02	185.10	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26433	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3959036	0.277675579	3.15084	339.68569	4.52754	355.48651	140.84297	1.0082952	1.7835119	602.39508
2	1.1815418	0.233405721	0.32231	170.85059	57.71757	173.15022	302.24569	0.9057632	1.4573204	469.10717

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.38114	16.18077	21.12350	1.23730	0.47802	0.38488
800.00000	51.60000	1.38114	44.15737	354.83956	0.98685	-0.08912	0.96214

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		200.00	721.00		921.00			
Flight/Stay		200.00		521.00	200.00				
Esc/Cap Orbits (radii)									
Apoapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		1.0083		0.9935					
Maximum Heliocentric		1.6418		1.4573					
Geocentric	0.0000		1.3497	1.4798		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	4.35		4.00	3.84		6.26			
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00			
Vel Losses (m/sec)	59.36		0.00	15.41		0.00			
Propellant (kg or t)	31.34	0.00	0.00	15.76	0.00	0.00			
Burn time (hr)	0.36		0.00	0.17		0.00			
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 4, 2022, 12.0000 hours GMT Julian Date 59827.0000	Mars MAR 23, 2023, 12.0000 hours GMT Julian Date 60027.0000	200.0000
2	518.9959	Mars AUG 23, 2024, 11.9010 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9010 hours GMT Julian Date 60745.9959	200.0000
Total Duration				318.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.199	6.000	30.964	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.32003	46.38	64.05	21.302	1.36691	57.261	3.92739	-19.82	185.53	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3931928	0.276294349	3.08263	341.62414	2.63335	357.37920	141.69838	1.0082615	1.7781241	600.64138
2	1.1815418	0.233405661	0.32231	170.85059	57.71755	173.15022	302.24571	0.9057632	1.4573203	469.10716

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36691	14.79379	19.86671	1.24294	0.44912	0.34903
800.00000	51.60000	1.36691	44.81383	352.26459	0.96086	-0.13052	0.96340

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	719.00		919.00
Flight/Stay		200.00		519.00	200.00	
Esc/Cap Orbits (radial)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0083			0.9935	
Maximum Heliocentric		1.6431			1.4573	
Geocentric	0.0000		1.3697	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.32		3.93	3.84		6.26
Eff Delta-V (km/sec)	1.37	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	57.26		0.00	15.41		0.00
Propellant (kg or t)	30.96	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

File Name: Loaded Case

Leg 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 6, 2022, 12.0000 hours GMT Julian Date 59829.0000	Mars MAR 25, 2023, 12.0000 hours GMT Julian Date 60029.0000	200.0000
2	516.9959	Mars AUG 23, 2024, 11.9008 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9008 hours GMT Julian Date 60745.9959	200.0000
Total Duration				916.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.981	6.000	30.746	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.30121	45.62	61.90	21.152	1.35858	56.062	3.85562	-19.60	185.90	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3903358	0.275010618	3.01779	343.56458	0.69785	359.31311	142.59166	1.0079787	1.7726929	598.79473
2	1.1815418	0.233405601	0.32232	170.85059	57.71753	173.15022	302.24572	0.9057633	1.4573202	469.10714

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35858	13.38983	18.67918	1.25204	0.42328	0.31461
800.00000	51.60000	1.35858	45.54365	349.87332	0.93668	-0.16730	0.96973

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	717.00		917.00
Flight/Stay		200.00		517.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0080			0.9935	
Maximum Heliocentric		1.6444			1.4573	
Geocentric	0.0000		1.3896	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.86	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	56.06		0.00	15.41		0.00
Propellant (kg or t)	30.75	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 7, 2023, 12.0000 hours GMT Julian Date 59830.0000	Mars MAR 26, 2023, 12.0000 hours GMT Julian Date 60030.0000	200.0000
2	515.9959	Mars AUG 23, 2024, 11.9007 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9007 hours GMT Julian Date 60745.9959	200.0000
Total Duration				715.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	118.931	6.000	30.696	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.803
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29688	45.21	60.82	21.118	1.35668	55.790	3.81981	-19.48	186.06	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure	Arrival	Perihelion (AU)	Aphelion (AU)	Period (days)
						True Anom (deg)	True Anom (deg)			
1	1.3888531	0.274408499	2.98654	344.53555	359.71465	0.29549	143.05247	1.0077400	1.7699662	597.83714
2	1.1815418	0.233405571	0.32232	170.85059	57.71751	173.15022	302.24573	0.9057633	1.4573202	469.10713

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35668	12.68680	18.11631	1.25794	0.41156	0.29796
800.00000	51.60000	1.35668	45.92999	348.76943	0.92555	-0.18378	0.97476

MISSION OPERATIONS

	Earth		Mars		Earth	
	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)						
Depart/Arrive	0.00		200.00	716.00		916.00
Flight/Stay		200.00		516.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0077			0.9935	
Maximum Heliocentric		1.6450			1.4573	
Geocentric	0.0000		1.3995	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.82	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.79		0.00	15.41		0.00
Propellant (kg or t)	30.70	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Stay Time (days)	Depart		Arrive		Flight Time (days)
514.9959	Earth	SEP 8, 2022, 12.0000 hours GMT Julian Date 59831.0000	Mars	MAR 27, 2023, 12.0000 hours GMT Julian Date 60031.0000	200.0000
	Mars	AUG 23, 2024, 11.9006 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9006 hours GMT Julian Date 60745.9959	201.0000
	Total Duration				514.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propeill	Tankage	Engine	Propeill	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.921	6.000	30.686	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29603	44.78	59.76	21.111	1.35630	55.737	3.78409	-19.35	186.20	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3873347	0.273834617	2.95604	345.50704	358.72118	1.28811	143.52268	1.0074344	1.7672350	536.85700
2	1.1815417	0.233405541	0.32232	170.85059	57.71750	173.15022	302.24574	0.9057634	1.4573201	469.10713

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35630	11.98622	17.57641	1.26479	0.40064	0.28167
800.00000	51.60000	1.35630	46.32683	347.73845	0.91522	-0.19891	0.98100

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Earth Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	715.00		915.00
Flight/Stay		200.00		200.00		
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0075			0.9935	
Maximum Heliocentric		1.6457			1.4573	
Geocentric	0.0000		1.4094	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.78	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.74		0.00	15.41		0.00
Propellant (kg or t)	30.69	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 9, 2022, 12.0000 hours GMT Julian Date 59832.0000	Mars MAR 28, 2023, 12.0000 hours GMT Julian Date 60032.0000	200.0000
2	513.9959	Mars AUG 23, 2024, 11.9005 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9005 hours GMT Julian Date 60745.9959	513.9959
Total Duration				713.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.952	6.000	30.717	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29871	44.33	58.70	21.132	1.35748	55.905	3.74844	-19.22	186.33	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3857809	0.273290302	2.92626	346.47904	357.71749	2.29092	144.00226	1.0070604	1.7645014	595.85459
2	1.1815417	0.233405512	0.32232	170.85059	57.71749	173.15022	302.24574	0.9057634	1.4573201	469.10712

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35748	11.29056	17.06114	1.27263	0.39057	0.26577
800.00000	51.60000	1.35748	46.73100	346.78866	0.90583	-0.21265	0.98844

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	714.00		914.00
Flight/Stay		200.00		514.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0072			0.9935	
Maximum Heliocentric		1.6463			1.4573	
Geocentric	0.0000		1.4193	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.75	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.90		0.00	15.41		0.00
Propellant (kg or t)	30.72	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth SEP 10, 2022, 12.0000 hours GMT Julian Date 59833.0000	Mars MAR 29, 2023, 12.0000 hours GMT Julian Date 60033.0000	210.0000
2	512.9959	Mars AUG 23, 2024, 11.9004 hours GMT Julian Date 60545.9959	Earth MAR 11, 2025, 11.9004 hours GMT Julian Date 60745.9959	200.0000
Total Duration				412.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.024	6.000	30.789	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.30496	43.86	57.65	21.182	1.36024	56.299	3.71291	-19.08	186.44	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3841920	0.272776903	2.89717	347.45155	356.70365	3.30386	144.49113	1.0066164	1.7617676	594.83008
2	1.1815417	0.233405482	0.32232	170.85060	57.71748	173.15022	302.24575	0.9057634	1.4573200	469.10711

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36024	10.60236	16.57202	1.28148	0.38134	0.25027
800.00000	51.60000	1.36024	47.13919	345.92768	0.89749	-0.22497	0.99707

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	713.00		913.00
Flight/Stay		200.00		513.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0070			0.9935	
Maximum Heliocentric		1.6469			1.4573	
Geocentric	0.0000		1.4292	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.71	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	56.30		0.00	15.41		0.00
Propellant (kg or t)	30.79	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time Days
1	511.9958	Earth SEP 11, 2022, 12.0000 hours GMT Julian Date 59834.0000	Mars MAR 30, 2023, 12.0000 hours GMT Julian Date 60034.0000	200.0000
		Mars AUG 23, 2024, 11.9003 hours GMT Julian Date 60545.9958	Earth MAR 11, 2025, 11.9003 hours GMT Julian Date 60745.9958	200.0000
Total Duration				911.9958

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart			Arrive			Inert	Probes	AeroBrk	Drops	Samples	NetMass
		Engine	Propell	Tankage	Engine	Propell	Tankage						
1	119.138	6.000	30.903	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.31482	43.37	56.63	21.260	1.36460	56.926	3.67749	-18.93	186.54	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure	Arrival	Perihelion (AU)	Aphelion (AU)	Period (days)
						True Anom (deg)	True Anom (deg)			
1	1.3825683	0.272295783	2.86875	348.42459	355.67973	4.32685	144.98922	1.0061008	1.7590358	593.78375
2	1.1815417	0.233405452	0.32232	170.85060	57.71747	173.15022	302.24576	0.9057634	1.4573200	469.10711

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36460	9.92414	16.11047	1.29139	0.37300	0.23518
800.00000	51.60000	1.36460	47.54795	345.16235	0.89035	-0.23587	1.00686

MISSION OPERATIONS

	Earth			Mars			Earth		
	Dep	Helio	Arr	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		200.00	712.00		912.00			
Flight/Stay		200.00		512.00		200.00			
Asc/Cap Orbits (radii)									
Apoapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		1.0067			0.9935				
Maximum Heliocentric		1.6475			1.4573				
Geocentric	0.0000		1.4391	1.4798		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	4.31		3.68	3.84		6.26			
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00			
Vel Losses (m/sec)	56.93		0.00	15.41		0.00			
Propellant (kg or t)	30.90	0.00	0.00	15.76	0.00	0.00			
Burn time (hr)	0.35		0.00	0.17		0.00			
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
		Earth	Mars	
		SEP 13, 2022, 12.0000 hours GMT Julian Date 59836.0000	APR 1, 2023, 12.0000 hours GMT Julian Date 60636.0000	200.0000
	509.9958	Mars	Earth	
		AUG 23, 2024, 11.9001 hours GMT Julian Date 60545.9958	MAR 11, 2025, 11.9001 hours GMT Julian Date 60745.9958	200.0000
Total Duration				909.9958

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.497	6.000	31.262	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.34547	42.35	54.65	21.507	1.37824	58.925	3.60710	-18.61	186.68	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26431	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3792178	0.271435907	2.81381	350.37226	353.60205	6.40262	146.01269	1.0048486	1.7535870	591.62661
2	1.1815417	0.233405392	0.32232	170.85060	57.71745	173.15022	302.24577	0.9057635	1.4573199	469.10709

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.37824	8.60769	15.27520	1.31458	0.35902	0.20629
800.00000	51.60000	1.37824	48.35293	343.94129	0.88016	-0.25336	1.02990

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Earth Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	710.00		910.00
Flight/Stay		200.00		200.00		
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0062		0.9935		
Maximum Heliocentric		1.6487		1.4573		
Geocentric	0.0000		1.4588	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.35		3.61	3.84		6.26
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	58.92		0.00	15.41		0.00
Propellant (kg or t)	31.26	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Stay Time (days)	Depart		Arrive	Flight Time (days)
	Earth	SEP 14, 2022, 4.0671 hours GMT Julian Date 59836.6695	Mars	APR 2, 2023, 4.0671 hours GMT Julian Date 60036.6695
509.3264	Mars	AUG 23, 2024, 11.9000 hours GMT Julian Date 60545.9958	Earth	MAR 11, 2025, 11.9000 hours GMT Julian Date 60745.9958
				Total Duration 309.3264

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SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.656	6.000	31.421	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.913
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.35900	42.00	54.01	21.617	1.38432	59.831	3.58369	-18.49	186.71	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26431	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3780659	0.271180095	2.79597	351.02468	352.89782	7.10619	146.36329	1.0043619	1.7517700	590.88563
2	1.1815417	0.233405372	0.32232	170.85060	57.71744	173.15022	302.24578	0.9057635	1.4573199	469.10709

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.38432	8.18158	15.02302	1.32339	0.35517	0.19700
800.00000	51.60000	1.38432	48.61476	343.62964	0.87809	-0.25794	1.03863

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		200.00	709.33		909.33			
Flight/Stay		200.00		509.33	200.00				
30/Cap Orbits (radii)									
Apcapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		1.0060			0.9935				
Maximum Heliocentric		1.6490			1.4573				
Geocentric	0.0000		1.4654	1.4798		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	4.36		3.58	3.84		6.26			
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00			
Vel Losses (m/sec)	59.83		0.00	15.41		0.00			
Propellant (kg or t)	31.42	0.00	0.00	15.76	0.00	0.00			
Burn time (hr)	0.36		0.00	0.17		0.00			
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth OCT 9, 2024, 12.0000 hours GMT Julian Date 60592.0000	Mars MAY 5, 2025, 4.4291 hours GMT Julian Date 60900.6448	208.6845
2	513.2570	Mars SEP 30, 2026, 10.5960 hours GMT Julian Date 61313.9415	Earth APR 18, 2027, 10.5960 hours GMT Julian Date 61513.9415	1202.0000
Total Duration				921.9415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	48.90	108.57	21.045	1.35434	55.296	4.82626	-29.11	232.32	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3868010	0.279785537	3.23528	15.38136	2.69835	357.28155	146.01688	0.9987941	1.7748078	596.51260
2	1.2361880	0.260104758	1.27868	27.87954	235.25057	181.89730	304.67056	0.9146496	1.5577263	502.02480

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	19.64712	59.68520	0.64381	1.10109	0.45536
800.00000	51.60000	1.35434	41.23676	37.90962	0.80354	0.62576	0.89274

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Earth Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		208.68	721.94		921.94
Flight/Stay		208.68	513.26		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9988			1.0040	
Maximum Heliocentric		1.6644			1.5574	
Geocentric	0.0000		1.4604	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.83	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth OCT 10, 2024, 12.0000 hours GMT Julian Date 60594.0000	Mars MAY 2, 2025, 11.1837 hours GMT Julian Date 60797.9660	203.9660
2	515.9755	Mars SEP 30, 2026, 10.5955 hours GMT Julian Date 61313.9415	Earth APR 18, 2027, 10.5955 hours GMT Julian Date 61513.9415	200.0100
Total Duration				414.415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell Tankage	Arrive Engine Propell Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590 0.000	0.000 0.000 0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635 0.000	0.000 0.000 0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	46.98	107.40	21.045	1.35434	55.296	4.98228	-27.84	232.67	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3937281	0.283642741	2.99740	17.36082	1.30228	358.67403	144.24864	0.9984072	1.7890490	600.98760
2	1.2361879	0.260104738	1.27868	27.87954	235.25056	181.89729	304.67055	0.9146496	1.5577262	502.02478

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	15.71553	62.15622	0.60892	1.15277	0.36684
800.00000	51.60000	1.35434	44.01033	35.50621	0.79294	0.56573	0.94098

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		203.97	719.94		919.94			
Flight/Stay		203.97		515.98		200.00			
Esc/Cap Orbits (radii)									
Apoapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		0.9984			1.0040				
Maximum Heliocentric		1.6648			1.5574				
Geocentric	0.0000		1.4354	1.6690		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	4.29		4.98	3.82		6.81			
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00			
Vel Losses (m/sec)	55.30		0.00	15.03		0.00			
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00			
Burn time (hr)	0.35		0.00	0.17		0.00			
Thrust (lbs or kibs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
		Earth	Mars	
		OCT 12, 2024, 12.0000 hours GMT Julian Date 60596.0000	MAY 2, 2025, 0.4686 hours GMT Julian Date 60797.5136	201.5136
	516.4219	Mars	Earth	
		SEP 30, 2026, 10.5950 hours GMT Julian Date 61313.9415	APR 18, 2027, 10.5950 hours GMT Julian Date 61513.9415	500.0000
Total Duration				917.9415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	45.86	105.46	21.045	1.35434	55.296	5.02196	-27.09	232.99	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3952564	0.284799605	2.84632	19.34228	359.53967	0.43332	143.83732	0.9978879	1.7926249	601.97540
2	1.2361878	0.260104717	1.27868	27.87954	235.25055	181.89728	304.67054	0.9146495	1.5577261	502.00474

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	13.73068	61.88002	0.62009	1.16034	0.32146
800.00000	51.60000	1.35434	45.27230	33.35667	0.79609	0.52406	0.96220

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		201.52	717.94		917.94
Flight/Stay		201.52		516.42	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9979			1.0040	
Maximum Heliocentric		1.6649			1.5574	
Geocentric	0.0000		1.4313	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		5.02	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth OCT 14, 2024, 12.0000 hours GMT Julian Date 60598.0000	Mars MAY 3, 2025, 8.0684 hours GMT Julian Date 60798.8362	200.8362
2	515.1053	Mars SEP 30, 2026, 10.5946 hours GMT Julian Date 61313.9414	Earth APR 18, 2027, 10.5946 hours GMT Julian Date 61513.9414	200.1053
Total Duration				915.9414

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	45.17	102.84	21.045	1.35434	55.296	4.96471	-26.65	233.31	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3921562	0.283763916	2.74406	21.32581	357.45764	2.51223	144.51343	0.9971125	1.7871999	599.97114
2	1.2361878	0.260104696	1.27868	27.87954	235.25054	181.89727	304.67053	0.9146495	1.5577260	502.02469

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.58702	60.16505	0.65760	1.14660	0.29514
800.00000	51.60000	1.35434	45.95496	30.74266	0.80925	0.48131	0.97349

MISSION OPERATIONS

	Earth Dep	Helio	Arr	Mars Dep	Helio	Arr	Earth
Times (days)							
Depart/Arrive	0.00		200.84	715.94		915.94	
Flight/Stay		200.84		515.11	200.00		
Esc/Cap Orbits (radii)							
Apoapse Distance	12.09		0.00	10.95		0.00	
Periapse Distance	1.13		0.00	1.07		0.00	
Spacecraft Distances (AU)							
Minimum Heliocentric		0.9973			1.0040		
Maximum Heliocentric		1.6647			1.5574		
Geocentric	0.0000		1.4434	1.6690		0.0000	
Maneuvers							
Propulsion Type	Vloss		None	Vloss		None	
Vinf (km/sec)	4.29		4.96	3.82		6.81	
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00	
Vel Losses (m/sec)	55.30		0.00	15.03		0.00	
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00	
Burn time (hr)	0.35		0.00	0.17		0.00	
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00	
Spec Imp (sec)	463.4		0.0	442.1		0.0	
Mass Changes (kg or t)							
Dry Stage Jettisoned	6.00		0.00	6.30		0.00	
Probes Separated				17.31		23.56	
AeroBrake Separated				13.10		0.00	
Drop Mass Left				0.00		0.00	
Sample Mass Added				0.00		0.00	

Leg	Stay Time (days)	Depart	Arrive	Flight Time (days)
1		Earth OCT 16, 2024, 12.0000 hours GMT Julian Date 60600.0000	Mars MAY 6, 2025, 22.6388 hours GMT Julian Date 60402.4433	212.4433
2	511.4982	Mars SEP 30, 2026, 10.5941 hours GMT Julian Date 61313.9414	Earth APR 18, 2027, 10.5941 hours GMT Julian Date 61513.9414	200.0000
Total Duration				413.9414

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart						Arrive					
	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	44.84	99.34	21.045	1.35434	55.296	4.78347	-26.48	233.63	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3834420	0.280110268	2.68532	23.31126	354.96198	5.00510	146.60265	0.9959257	1.7709583	594.34662
2	1.2361877	0.260104676	1.27868	27.87954	235.25053	181.89726	304.67053	0.9146495	1.5577259	500.02465

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.05664	57.06835	0.72003	1.11165	0.28289
800.00000	51.60000	1.35434	46.26018	27.27353	0.83227	0.42908	0.97849

MISSION OPERATIONS

	Earth			Mars			Earth		
	Dep	Helio	Arr	Dep	Helio	Arr	Dep	Helio	Arr
Times (days)									
Depart/Arrive	0.00		202.44	713.94		913.94			
Flight/Stay		202.44		511.50		200.00			
Esc/Cap Orbits (radii)									
Apoapse Distance	12.09		0.00	10.95		0.00			
Periapse Distance	1.13		0.00	1.07		0.00			
Spacecraft Distances (AU)									
Minimum Heliocentric		0.9968			1.0040				
Maximum Heliocentric		1.6640			1.5574				
Geocentric	0.0000		1.4764	1.6690		0.0000			
Maneuvers									
Propulsion Type	Vloss		None	Vloss		None			
Vinf (km/sec)	4.29		4.78	3.82		6.81			
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00			
Vel Losses (m/sec)	55.30		0.00	15.03		0.00			
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00			
Burn time (hr)	0.35		0.00	0.17		0.00			
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00			
Spec Imp (sec)	463.4		0.0	442.1		0.0			
Mass Changes (kg or t)									
Dry Stage Jettisoned	6.00		0.00	6.30		0.00			
Probes Separated				17.31		23.56			
AeroBrake Separated				13.10		0.00			
Drop Mass Left				0.00		0.00			
Sample Mass Added				0.00		0.00			

Leg	Stay Time (days)	Depart	Arrive	Flight Duration
		Earth	Mars	209.0791
		OCT 18, 2024, 12.0000 hours GMT Julian Date 60602.0000	MAY 15, 2025, 13.8983 hours GMT Julian Date 60811.0791	
502.8623		Mars	Earth	338.6222
		SEP 30, 2026, 10.5936 hours GMT Julian Date 61313.9414	APR 18, 2027, 10.5936 hours GMT Julian Date 61513.9414	
Total Duration				547.7013

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Engine	Depart Propell	Tankage	Engine	Arrive Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.559	0.000	0.000	0.000	6.000

DEPARTURE/ARRIVAL CONDITIONS

Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29200	45.10	94.13	21.045	1.35434	55.296	4.35801	-26.85	233.76	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3650918	0.271865766	2.70347	25.29803	351.67753	8.28769	151.68367	0.9939701	1.7362135	592.56073
2	1.2361876	0.260104655	1.27868	27.87954	235.25052	181.89725	304.67052	0.9146495	1.5577258	502.02461

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.46738	51.54822	0.82234	1.03562	0.29238
800.00000	51.60000	1.35434	46.02445	22.03937	0.87167	0.35287	0.97463

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Earth Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		209.08	711.94		911.94
Flight/Stay		209.08	502.86	200.00		
sc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9962		1.0040		
Maximum Heliocentric		1.6620		1.5574		
Geocentric	0.0000		1.5541	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.36	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated				17.31		23.56
AeroBrake Separated				13.10		0.00
Drop Mass Left				0.00		0.00
Sample Mass Added				0.00		0.00

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